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TOTAL QUALITY MANAGEMENT IN TEN EXEMPLARY
DEPARTMENT OF DEFENSE ORGANIZATIONS:
LESSONS LEARNED, INNOVATIVE PRACTICES, AND
QUALITY MEASUREMENTS

Carolyn Applegate 
Susan P. Hocevar
Kenneth W. Thomas

November, 1991

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Prepared for: Naval Avionics Center, Indianapolis, Indiana

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**Lieutenant Carolyn Applegate
Professor Susan Page Hocevar
Professor Kenneth W. Thomas**

Naval Postgraduate School

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Abstract

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TABLE OF CONTENTS

I.	INTRODUCTION	1
	A. THE QUALITY REVOLUTION IN THE PUBLIC SECTOR	1
	B. RESEARCH OBJECTIVE	2
II.	BACKGROUND	3
	A. LITERATURE REVIEW: QUALITY MANAGEMENT	3
	B. HISTORY OF TOTAL QUALITY MANAGEMENT IN DOD	6
	C. QUALITY ASSESSMENT	9
III.	METHODOLOGY	13
	A. RESEARCH STRATEGY	13
	B. CHOICE OF ORGANIZATIONS	13
	C. QUESTIONNAIRE SURVEY	14
	D. DOCUMENTATION	15
	E. INTERVIEW	18
IV.	RESULTS	20
	A. INTERVIEW	20
	1. Question 1: Lessons Learned	20
	a. Top Management Commitment	20
	b. Structured Approach	21
	c. Training and Education	23
	d. Performance Evaluation	24
	e. Resistance to Change	25
	f. Relentless Pursuit of Quality Transformation	28
	2. Question 2: Organizational Structure	29
	a. Flattened Structure	29
	b. Functional to Product Orientation	30
	c. Self-Managed Work Teams	30
	3. Question 3: Strategic Planning and Implementation	30

4. Question 4: Customer Satisfaction	31
a. Customer Evaluation Card	31
b. Customer Surveys	32
c. Customer Liaison	32
d. Customer Education	33
e. Official Deficiency Reports	33
f. Employee Attitude Surveys	34
g. Listening	34
5. Question 5: Quality Assessment	34
B. SURVEY	36
V. INNOVATIVE PRACTICES	39
A. STRATEGIC PLANNING AND IMPLEMENTATION	39
1. Process	39
2. Bill of Rights	40
B. SELF-MANAGING WORK TEAMS	41
C. QUALITY MEASUREMENTS	42
1. The Management Healthcheck	42
2. Supplier Quality Management	42
D. TRAINING	43
1. Exposure	43
2. Learning Centers	44
3. Competency Based Certification	45
E. RECOGNITION AND REWARD SYSTEMS	46
1. New Ideas	46
2. Special Acts	47
3. Peer to Peer Recognition	47
4. Ceremonies	48
5. Productivity Gain Sharing	48

F. PERFORMANCE APPRAISAL SYSTEMS	49
1. Alignment	49
2. PACER SHARE	50
G. COMMUNICATION	51
1. Written Media	51
2. Electronic Mail	51
3. Meetings	52
4. Behavioral Feedback	52
5. Mentoring	52
VI. SUMMARY AND GENERAL CONCLUSIONS	54
A. SUMMARY	54
B. GENERAL CONCLUSIONS	54
1. Comparison with DoD's TQM Guidelines	54
2. Current State of Quality Measurement	55
3. Need to Integrate TQM with Strategic Planning	56
4. An Overall Assessment of Promise	57
APPENDIX A: SURVEY QUESTIONS	58
APPENDIX B: STATISTICAL ANALYSIS OF SURVEY RESULTS	65
APPENDIX C: RESEARCH PARTICIPANTS	68
APPENDIX D: TQM TRAINING COURSES	70
LIST OF REFERENCES	72

I. INTRODUCTION

A. THE QUALITY REVOLUTION IN THE PUBLIC SECTOR

During the 1980s, the total quality movement acted as a catalyst to private sector manufacturing industries; now, quality practices are becoming a focal point in service industries in both private and public sectors. Private sector businesses undertake fundamental change for reasons of efficiency and survival; likewise, today, the government is also faced with tremendous pressure to economize. The last few years of austere funding have provided an impetus to change and improve, by challenging Department of Defense (DOD) activities to increase productivity and cope with shrinking budgets. To face this challenge, some public managers have embraced the quality movement as a path by which progressive business practices can impact cost, efficiency and quality of DOD services.

A quality focus requires a shift toward a human resource revolution which emphasizes people, not machines. Can the public sector offer its customers the same quality of services they have come to expect from quality leaders in the private sector? The answer is yes. As proof, several of DOD's 'business units' are achieving higher quality, productivity, and cost savings, which allow them to compete successfully with private sector businesses. Some of those successful organizations were the focus of this research.

B. RESEARCH OBJECTIVE

The aim of this research is to provide qualitative and quantitative analyses of Total Quality Management implementation in the Department of Defense. It describes lessons learned by top executives during TQM implementation, as well as innovative practices used to help solve the problems of implementation. The results provide thought-provoking information for organizations already embarked on TQM implementation, as well as those just starting to focus on quality management. In addition, this research measures perceptions of quality management within participating organizations using a validated research instrument.

This report is not a prescriptive, "how-to" guide for implementing TQM. Research results are not meant to provide rules for managing quality because each organization must structure its implementation efforts to fit its mission and culture. Rather, this represents an exploratory study into real-world lessons learned during TQM implementation by top executives in DOD. Quality is examined in terms of critical factors, rather than a specific quality expert's teachings.

II. BACKGROUND

A. LITERATURE REVIEW: QUALITY MANAGEMENT

Various authors on quality recommend principles for effectively managing quality. These include Deming (1982;1986), Juran's (1986) quality trilogy, Crosby's (1979) zero-defect improvement programs, Ishikawa's (1985) total quality control, and Leonard and Sasser's (1982) identification of quality levers. It is notable that all of these authors discuss the ideals of top management commitment, education, continuous improvement, and employee involvement. Examination of these and other principles provides a foundation for recognizing areas critical to any change in quality focus.

The first thorough and systematic attempt to synthesize some of these quality concepts is shown in Table 1, adapted from a previous study (Sarah, Benson and Schroeder, 1989). Building on the writings of quality management authors, Sarah et al. propose organizational requirements for effective quality management. These organizational requirements are classified into eight critical factors necessary to achieve a successful shift to a quality focus. They include: the role of management, leadership and quality policy; the role of the quality department; training; product and service design; supplier quality management; process management; quality data and reporting; and employee relations.

In addition to the authors summarized in Table 1, other authors emphasize the importance of cross-functional teams and product design. Specifically, the criticality of design is indicated by Taguchi and Clausing (1990) who claim "quality is a virtue of design." Hauser and

Table 1: ORGANIZATIONAL REQUIREMENTS FOR EFFECTIVE QUALITY MANAGEMENT EMPHASIZED BY SELECTED AUTHORS (adapted from Saraph et al., 1989)

Critical Factors	(Crosby, 1979)	(Deming, 1982; 1986)	(Garvin, 1983)	(Juran, 1978; 1986; 1989)	(Ishikawa, 1985)	(Leonard and Sasser, 1982)
Role of top management leadership and quality policy	Management commitment, quality goal setting.	Define management's permanent commitment to implement Deming's principles. Create constancy of purpose towards quality. Adopt new management philosophy towards defects, mistakes, and defective materials.	Set quality programs and policies, attitudes of management and employees.	Upper management leadership and quality policy.	Personal concern for quality and quality-conscious management style. Assign responsibility for quality. Top management's strategic support for quality.	
Role of the quality department			Quality councils. Quality improvement teams.	Organizational mechanism/ program to improve quality.	Quality function is the responsibility of all departments.	Professional quality assurance and control staff.
Training		Supervisor and employee training.	Use modern methods of training using statistics. Institute vigorous program of training and education.	Training, at all levels appropriate to quality tools.	Training of employees in problem solving, data analysis and statistical techniques.	Training and development of management and employees.
Product/service design				Product design through reliability planning, trial production, and testing and producibility.	Product design emphasizing fitness for use.	

Supplier quality management	Reduce suppliers, award contracts on basis of quality. Do not choose suppliers on cost alone.	Vendor management by streamlining vendors, long term relationships, emphasis on quality, not cost.	Vendor relations using statistical methods.
Process management	Qualification of process. Corrective action. Zero defect planning. Error-cause removal.	Use statistical tools in manufacturing and purchasing. Search continually for problems in system (design, materials, machines, training, supervision). Emphasize teamwork for solving quality problems (sales, manufacturing, research and design).	Production and workforce policies, smooth production schedule.
Quality data and reporting	Quality measurement. Cost of quality.	Use statistical methods to improve quality continuously.	Process design emphasizing quality planning and quality improvement.
Employee relations	Employee recognition. Quality awareness. Zero-defect day.	Employee involvement in quality improvement at all levels and in all functions.	Process improvement through problem analysis.
			Organization-wide analysis of quality problems.
			Quality data gathering and analysis at all levels.
			Quality information system, including cost of quality, external and internal failure data.
			Quality information system for effective decision making at management and employee levels.
			Open participation by employees in quality improvement.
			Employee involvement in quality problem solving.
			Encourage communication.

Clausing (1988) propose the use of quality function deployment as a method to improve the quality of product design. The principle underlying quality function deployment is to disperse responsibility for quality. This can be achieved by establishing clear relations between manufacturing functions and customer satisfaction using a matrix organization design that breaks down functional barriers and encourages team work.

B. HISTORY OF TOTAL QUALITY MANAGEMENT IN DOD

The President of the United States signed Executive Order 12552 on 25 February 1986, establishing a Productivity Improvement Program for the federal government, in order to improve the efficiency, quality, and timeliness of service to the public with a 20% increase in selected areas by 1992. Subsequently, Executive Order 12637 of 27 April 1988 emphasized quality and modified the goal to an annual productivity increase of 3%. This translates into maintaining productivity levels with a 3% per annum decrease in budget. About the same time in the private sector, Public Law 100-107 established a national quality award on August 20, 1987--the Malcolm Baldridge National Quality Award.

DOD established a productivity program as detailed in DOD Directive 5010.31 which provides guidance and policy for improving in-house efficiency and effectiveness in the military. Over the years, evolution of improvement efforts changed from 'productivity' improvement to 'total performance' improvement to recognition that total quality management has the best potential for continuous improvement in the long term. (Garrett, 1988a) This change in wording reflects an understanding that long term

success depends not only on increasing productivity, but by continually improving all aspects of management.

In 1988, the Secretary of Defense issued a DOD posture statement on Total Quality Management (Carlucci, 1988), from whence the major services issued their own endorsements in-house (Garrett, 1988a; Garrett, 1988b; Secretary, 1988; Stone, 1988). Service actions included setting up executive steering committees to provide guidance on implementation and institutionalization of TQM, and to serve as a forum for exchange of information and lessons learned. During the administration changeover after the 1988 presidential election, activity at the DOD level slowed and some of the military services picked up the slack at the individual services' secretariat level. The following discussion outlines some major efforts in TQM implementation within the three military services and one DOD agency.

The Air Force relies on its field commanders to lead TQM implementation; nine of the 14 major Air Force commands have active total quality management efforts as directed by the Corona conference, a top-level gathering of Air Force leadership (Defense, 1991). Senior leadership emphasizes education and awareness of TQM principles and tools, as well as networking through the Air Force Productivity Action Group. This group, composed of secretariat, staff and field members, meets to review, adopt, and reap benefits from field ideas. One of the Air Force's chief success stories is its Aeronautical Systems Division (ASD), which has set out to systematically change its culture. ASD has documented significant improvements in their source selection process, change order cycle time, personnel management systems, and relations with suppliers.

The Army drafted its TQM plan in response to an Undersecretary of Defense memorandum in 1988 (Costello, 1988). The Army's executive steering group conducted a few meetings, issued their endorsement of TQM (Secretary, 1988; Stone, 1988), then got caught up in administrative changeover during 1988-9; activity at the secretariat level was suspended and momentum was lost. The Army's future plans include issuing a formal document rallying support for TQM through training. However, a recent Army Science Board Report found that senior and middle level Army leadership has not demonstrated a visible commitment to TQM or developed the organization's integrated implementation plan (Francis et al., 1990).

A bright spot in the Army's TQM implementation is the Army Material Command--a front-runner with continuous top management support and commitment driving this successful operation (Tuttle, 1990; Wagner, 1988). Another promising example is the Army's Communication and Electronic Command (CECOM), which has reduced the time required to process contract justification and approval. They have also improved customer satisfaction with the contracting process, and thereby reduced contract protests and Congressional inquiries (Varian, 1990).

The Navy emphasizes leadership as the key to meeting the challenge of TQM implementation. Senior leadership endorsements exist at the secretariat level (Garrett, 1988a; Hoffmann, 1988) and at the Chief of Naval Operations (Kelso, 1991). The Navy's implementation plan (Garrett, 1988b) contains milestones for involving major functional areas in TQM. Overall, the Navy is striving for a system where decisions are based on facts, rather than intuition alone. The Navy's success stories are illustrated by the designation of several industrial facilities, such as

the Naval Aviation Depot at Cherry Point and the Norfolk Naval Shipyard, as quality improvement prototypes (QIP). Success is also found in other shore administrative establishments like the Naval Publications and Forms Center, which was recognized as a QIP. In terms of operational forces, ADM Kelso, Chief of Naval Operations, says, "...quality will become ever more important as our overseas force levels and budgets decline...I want to start now." (Phillips, 1991)

A TQM effort within DOD as a whole is illustrated by the Defense Logistics Agency. Their TQM implementation began with establishment of an executive steering group, which has focused organizational efforts on five areas: recruiting and training quality people, ensuring customer satisfaction, reducing costs, acquiring information systems to meet customer needs, and building an effective relationship with industry. In 1990, contract administration of the military services was consolidated with the Defense Logistics Agency becoming the Defense Contract Management Command. Quality management boards have continued to develop strategies to meet the five focus areas; results include programs that emphasize criteria other than price in the procurement arena, multi-year contracts, and direct shipping using commercial distribution systems instead of stockpiling at the depot level. (Defense, 1991)

C. QUALITY ASSESSMENT

For the past few years, top executives in a number of industries have been rethinking how to measure quality performance. During the 1980s, many managers involved in the quality movement came to realize that quality is a strategic weapon in a competitive world; this resulted in new

performance measures such as tracking defect rates and response times (Troxell, 1981). The impetus of growth of the Total Quality concept, development of the Malcolm Baldridge National Quality Award, and increasingly stringent manufacturer demands on quality of supplier goods have led to a broadening of performance measures through an emphasis on quality. (Eccles, 1991)

One problem with these new performance measurements is that relying on measurements of customer satisfaction, quality, and innovation is not as well ingrained in today's managers as financial performance measures. Current information resources do not readily support real-time management using new quality measures, because they were designed based on traditional accounting systems. Real-time, operational measures of quality management, which broaden the basis of organizational performance measurement, can aid decision-makers to influence critical areas such as process management in order to improve performance. (Goldratt and Cox, 1986)

Most organizations which use statistical process control tools collect performance data such as rework or defect rates that focus on production. However, these measures are limited in that they do not reflect organization-wide quality management. Sarah et al. (1989) identified eight critical areas representing the aspects of quality management described by central authors in this field, and as summarized in Table 1 in the previous section. They developed scaled measures of eight "critical factors," including process management, training, and supplier quality management, for example. Operational measures of these critical factors can form a profile of an organization's quality

management practices, while providing a benchmark for making decisions to achieve higher or more ideal levels of quality within an organization. The eight critical factors and an explanation of what they represent are shown in Table 2.

Another self-assessment tool for quality is readily available from the National Institute for Standards and Technology (NIST)--a Malcolm Baldridge National Quality Award application. The award was developed to recognize quality achievements of U.S. companies and publicize successful quality strategies.

This award examination is designed to serve as a diagnostic tool for an organization's overall quality management, as well as a basis from which to make awards. The Baldridge award criteria are divided into seven categories -- leadership, information and analysis, strategic quality planning, human resource utilization, quality assurance of products and services, quality results, and customer satisfaction. While there is a great deal of similarity between the Baldridge criteria and the eight factors of quality management developed by Saraph et al., there are some differences. Specifically, the Baldridge criteria include two elements not directly emphasized by Saraph et al. -- quality results and customer satisfaction.

Table 2: CRITICAL FACTORS OF QUALITY MANAGEMENT
 (adapted from Sarah et al., 1989)

Critical Factors of Quality Management	Explanation of Critical Factors
1. Role of management leadership and quality policy	Acceptance of quality responsibility by top management and department heads. Evaluation of top management on quality. Participation by top management in quality improvement efforts. Specificity of quality goals. Importance attached to quality in relation to cost and schedule. Comprehensive quality planning.
2. Role of the quality department	Visibility and autonomy of the quality department. Quality department's access to top management. Use of quality staff for consultation. Coordination between quality department and other departments. Effectiveness of the quality department.
3. Training	Provision of statistical training, trade training, and quality-related training for all employees.
4. Product/service design	Thorough scrub-down process. Involvement of all affected departments in design reviews. Emphasis on producibility. Clarity of specifications. Emphasis on quality, not roll-out schedule. Avoidance of frequent redesigns.
5. Supplier quality management	Fewer dependable suppliers. Reliance on supplier process control. Strong interdependence of supplier and customer. Purchasing policy emphasizing quality rather than price. Supplier quality control. Supplier assistance in product development.
6. Process management	Clarity of process ownership, boundaries, and steps. Less reliance on inspection. Use of statistical process control. Selective automation. Fool-proof process design. Preventive maintenance. Employee self-inspection. Automated testing.
7. Quality data and reporting	Use of quality cost data. Feedback of quality data to employees and managers for problem solving. Timely quality measurement. Evaluation of managers and employees based on quality performance. Availability of quality data.
8. Employee relations	Implementation of employee involvement and quality circles. Open employee participation in quality decisions. Responsibility of employees for quality. Employee recognition for superior quality performance. Effectiveness of supervision in handling quality issues. On-going quality awareness of all employees.

III. METHODOLOGY

A. RESEARCH STRATEGY

Because the principle aim of this research was to determine lessons learned by top management, personal interviewing was chosen as the primary methodology to elicit such information. Multiple data sources and methods were used to enhance the reliability of these findings. Interview data were supplemented with questionnaire data from a structured survey and with written documents. Both the survey data and documentation were used to develop interview questions. Strategic lessons learned were developed as an outcome of the interview process, while innovative practices resulted from both the interviews and documentation.

B. CHOICE OF ORGANIZATIONS

The purposes, procedures and evaluation criteria of several quality awards were analyzed to determine if any of these awards could be used to select DOD organizations with good track records of quality. The DOD/Office of Management and Budget's (OMB) Productivity/Quality Improvement Prototype (QIP) was selected as the criterion for research participation. The purpose of this award is to recognize early successes, provide models for productivity improvement in other agencies, and provide visibility for high achievers.

The Federal Quality Institute was contacted in order to develop a list of QIP winners and finalists since the award's inception in 1988. The resultant list identified 23 organizations, 11 of which were within DOD. All the DOD organizations were contacted and 10 agreed to

participate. Each DOD organization provided a point of contact responsible for all administration concerned with this study. The point of contact acted as a coordinator, receiving the pertinent number of surveys, making interview appointments with the top executive, providing requested documentation, distributing and collecting the surveys and mailing all back to the researcher.

C. QUESTIONNAIRE SURVEY

1. Survey Instrument

A survey was adapted from a private sector study which developed and validated an instrument to measure the critical factors of quality management (Sarah, Benson and Schroeder, 1989). The adapted form of the survey contains 66 questions composing the eight critical factors and describes a manager's perception of actual quality practices within his/her organization. Question wording was minimally modified to fit DoD organizations (e.g., "top executive" was changed to "commanding officer or executive director"). The modified survey as it was administered for this study is shown in Appendix A. Additional information on the reliability and validity of the survey instrument can be found in Appendix B.

A typical survey item, as shown below, allows managers to indicate their perception of the degree or extent of a given practice within their organization:

Amount of final inspection, review or checking	Extent or Degree of Current Practice Is				
	Very low	Low	Medium	High	Very High
	1	2	3	4	5

Survey respondents were instructed to circle the number that represented their perception of quality management practices in their organization.

Each critical factor was assessed using several component questions. For each component question and for each critical factor, the actual level of practice within or across organizations is represented by the average of the respondents' ratings for the component question or critical factor. The scale scores were calculated by summing the component item ratings and dividing by the number of items. The items comprising each critical factor along with the coefficient alpha statistic of internal consistency reliability are presented in Table 3.

2. Survey Administration

The survey respondents chosen within the ten organizations were members of each organization's quality council or executive steering committee, because these people serve to lead the quality focus within each organization. Each survey respondent assessed the degree or extent of actual quality management practices in his/her organization according to the measure described above. Table 4 lists the ten organizations anonymously, along with the number of responses anticipated and the number of survey responses received.

D. DOCUMENTATION

Various sources of documentation were used to develop both quantitative and qualitative background information on the ten participating organizations. These sources included individual applications for the QIP award, cost of quality data (defect rates, rework), strategic plans, and other documents detailing quality

**Table 3: INTERNAL CONSISTENCY RELIABILITY ANALYSIS RESULTS
FOR THE CRITICAL FACTORS OF QUALITY MANAGEMENT**

Critical factors and component questions	Coefficient Alpha
Role of top management leadership and quality policy	
-extent to which the top executive assumes responsibility for quality performance -acceptance of responsibility for quality by major branch/department heads within the organization -degree to which top management (commanding officer/executive director /major department heads) is evaluated for quality performance -extent to which top management supports long-term quality improvement process -degree of participation by major branch/department heads in the quality improvement process -extent to which top management has objectives for quality performance -specificity of quality goals within the organization -comprehensiveness of the goal-setting process for quality within the organization -extent to which quality goals and policy are understood within the organization -importance attached to quality by top management in relation to cost and schedule objectives -amount of review of quality issues in top management meetings -degree to which top management considers quality management as a way to increase revenues/reduce costs -degree of comprehensiveness of the quality plan within the organization	.91
Role of the quality department	
-visibility of the quality department -quality department's access to top management -autonomy of the quality department -amount of coordination between the quality department and other departments -effectiveness of the quality department in improving quality	.74
Training	
-specific work-skills training (technical and vocational) given to non-supervisory employees throughout the organization -quality-related training given to non-supervisory employees throughout the organization -quality-related training given to managers and supervisors throughout the organization -training in the "total quality concept" (i.e. philosophy of organization-wide responsibility for quality) throughout the organization -training in the basic statistical techniques (such as histograms and control charts) in the organization as a whole -training in advanced statistical techniques (such as design of experiments and regression analysis) in the organization as a whole -commitment of the top management to employee training -availability of resources for employee training	.74
Product/service design	
-thoroughness of new process/service design reviews before the process/service is implemented/produced -coordination among affected departments in the process/service development process -quality of new processes/services emphasized in relation to cost or schedule objectives -clarity of process/service specifications and procedures -extent to which implementation/producing is considered in the process/service design process -quality emphasis by customer service employees	.82

Supplier quality management

- extent to which suppliers are selected based on quality rather than price or schedule
- thoroughness of the supplier rating system
- reliance on reasonably few dependable suppliers
- amount of education of suppliers by the organization
- technical assistance provided to suppliers
- involvement of the supplier in the product development process
- extent to which longer term relationships are offered to suppliers
- clarity of specifications provided to suppliers

Process management

- use of acceptance sampling to accept/reject lots or batches of work
- amount of preventive equipment maintenance
- extent to which inspection, review or checking of work is automated
- amount of incoming inspection, review or checking
- amount of in-process inspection, review or checking
- amount of final inspection, review or checking
- stability of production schedule/work distribution
- degree of automation of the process
- extent to which the design is "fool-proof" and minimizes chances of employee errors
- clarity of work or process instructions given to employees

Quality data and reporting

- availability of cost of quality data in the organization
- availability of quality data (error rates, defect rates, scrap, defects)
- timeliness of the quality data
- extent to which quality data (cost of quality, defects, errors, scrap, etc.) are used as tools to manage quality
- extent to which quality data are available to non-supervisory employees
- extent to which quality data are available to managers and supervisors
- extent to which quality data are used to evaluate supervisor and managerial performance
- extent to which quality data, control charts, etc., are displayed at employees' workstations

Employee relations

- extent to which quality circle or employee involvement type programs are implemented in the organization
- effectiveness of the quality circle or employee involvement type programs in the organization
- extent to which employees are held responsible for error-free output
- amount of feedback provided to employees on their quality performance
- degree of participation in quality decisions by non-supervisory employees
- extent to which quality awareness building among employees is ongoing
- extent to which employees are recognized for superior quality performance
- effectiveness of supervisors in solving problems/issues

management practices within each organization. Additionally, several organizations' top executives' conference papers or videotaped presentations on quality within their organizations were also studied. Discussion of specific quality practices discussed in the documents is contained in Section V, as innovative practices.

Table 4: SURVEY RESPONSE

Organization	Surveys received	Surveys sent	Response rate
#1	7	7	100%
#2	11	13	85%
#3	14	25	56%
#4	10	15	67%
#5	10	12	83%
#6	11	15	73%
#7	20	27	74%
#8	8	8	100%
#9	6	12	50%
#10	5	8	63%
Total	102	142	72%

E. INTERVIEW

Nine of ten interviews were conducted by telephone and arranged like a normal business meeting on the executive's calendar. One interview was conducted at the Naval Postgraduate School in Monterey, California. Appendix C lists the ten participating organizations along with the name and title of each interviewee. Interview lengths varied from 25 minutes to over one hour and were conducted without a recording machine. Notes taken during each interview by the researcher were formally transcribed

within 24 hours to minimize loss of information. Also, a condition of each interview was that all comments and opinions would be treated anonymously in order to elicit free communication on all issues.

The following questions formed the core of each interview:

- What are some obstacles your organization has encountered during its TQM implementation, both internal and external to your organization, and how have you managed to get around them?
- Has your organization changed at all structurally as a result of your TQM implementation?
- Does your organization have a strategic plan/strategic quality plan?
- How does your organization identify, measure, and track customer satisfaction?
- How does your organization identify, measure, and track results of quality efforts?

In addition, other questions were tailored to each organization based on the survey results and documentation.

Data from the ten interviews were qualitatively analyzed using matrices to capture all descriptive information on a question, group the information by category, and place all evidence within each category. This method allowed for the determination of patterns of consistent responses. Strategic lessons learned are detailed in Section IV, while innovative practices are discussed in Section V.

IV. RESULTS

This section is divided into two main parts, the first, and most substantial focuses on the interview findings. The second summarizes the results of the questionnaire data examining the 8 critical factors of quality management.

A. INTERVIEW

This section is separated into five parts each focusing on the answers to separate interview questions.

1. Question 1: Lessons Learned

- What are some obstacles your organization has encountered during its TQM implementation, both internal and external to your organization, and how have you managed to get around them?

The presentation of responses to this question have been organized into six major categories: top management commitment, structured approach, training and education, performance evaluation, resistance to change, and relentless pursuit of the quality transformation.

a. Top Management Commitment

Five of the ten interviewees identified top management commitment as a vital element of TQM implementation. Recommendations included "managing by walking around," absolutely no delegation of commitment, and the necessity that the top executive act as the ultimate teacher of TQM. Several interviewees reinforced Deming's (1986) argument that commitment is "no instant pudding."

Others were concerned about continuity, or Deming's "constancy of purpose" (Deming, 1986). Several solutions to this problem were discussed, such as proactive communication to the workforce, TQM education

to all levels of the workforce, and tying promotions to successful behavior. A specific illustration described the value communicating the results of strategic planning as a strong message about what was important to top management. It is noteworthy that all interviewees tailored TQM principles to fit their own organizations; they modified both terminology and structures, thus providing evidence that there is "no cookbook approach" to TQM implementation.

The difficulty of achieving and demonstrating their personal commitment to TQM principles was frequently mentioned by the interviewees. A majority of the ten interviewees confessed to foundering in some way during development and expression of top management commitment. Three interviewees attributed this fact to their own inaction or inability to closely model their actions after their words. Two interviewees reported that they still fight their old behaviors and recommend the use of in-house facilitators to provide personal counsel. A repeated error noted was when senior management got excited about TQM through initial training and, wanting to "start now," began implementation too quickly. Two interviewees spoke specifically of failing to provide adequate awareness and skills training as well as top management guidance and clear expectations to middle management prior to "starting." Subsequent efforts at implementation at lower levels failed due to the lack of sufficient support or understanding on the part of middle management.

b. Structured Approach

Seven of the ten interviewees considered a structured approach to continuous improvement as another vital element of TQM implementation. They advocated improving the process, not simply fixing the problems,

using statistical process control (SPC) as the language of the process. In other words, they recommended identifying measureable criteria for change by "using data in steps of process definition, measurement, improvement and control." This reliance on data to analyze processes was seen to be an important change from decision making based on "gut feel" or without "competing strategies."

Two interviewees strongly advised against focusing on quality of work life (QWL), since their own organizations had made this mistake during initial stages of implementation. Because of the QWL emphasis, the focus of their TQM implementation was on internal customers rather than external customers. Results of this QWL focus included no improvement in product or service quality and a noticeable decline in product or service on-time delivery.

Institutionalization of change was also viewed as important, so that the continuous improvement process endures even after the top executive moves on to other responsibilities. Institutionalization relies on the use of formal policies, systems, and structures as well as on flexible, reassessable implementation plans. For example, one organization instituted formal systems, structures and policies including an executive steering committee, process action teams, a process-oriented focus through training. While this may not be unusual, the organization also established supporting policies in the areas of performance evaluation, rewards and job security as related to continuous improvement and total quality.

c. Training and Education

Eight of ten interviewees espoused education and training as mandatory foundations for any successful TQM implementation. Education is necessary to overcome lack of a real understanding of TQM principles by supervisors, customers, and superiors in the traditional chain of command. Interviewees strongly believed that there are "no shortcuts" in training and education, that "everyone must participate," and that it was vital to invest training dollars for the long term.

In particular, several interviewees expressed concern that many employees, including management, were uncomfortable with the level of math skills required for basic statistical process control (SPC) techniques. As a solution, several of these organizations developed core math courses so that any employee can brush up or learn new skills. In the area of human relations, the interviewees recognized that a majority of the workforce has limited experience in group dynamics; hence, several in-house education and training institutes were developed to teach team-building and workgroup skills. These are detailed in Chapter V.

The value of "just-in-time training" was a lesson learned by several interviewees who reported that the number of people trained is not as important as facilitating follow-up application. Teaching the right material at the right time to the right people with the right follow-up, optimized training efforts because "decay from the classroom to the workplace" easily happened without immediate practice and coaching. For example, at one organization, all supervisors were trained in basic statistical process control techniques, but only a few were actually transferring these new skills to the workplace. A lesson learned was that

this organization did not have a sufficient number of trained facilitators or coaches to guide the initial transfer of skills to a real process.

Similarly, one interviewee learned that "lots of philosophy without the tools" fails to transform the workforce. In one particular organization, most training associated with TQM concerned philosophy and not basic SPC; when transformation of the workforce failed to occur, the interviewee evaluated his situation and determined that he had emphasized awareness training to the detriment of skills training. Thus, some interviewees remarked learning that they could not simply train employees, sit back, and wait for results--TQM requires active, persistent leadership with plenty of guidance and expectations from top management, in order to succeed. "Top management must insist on the transfer of principles to jobs."

d. Performance Evaluation

Four of ten interviewees reported current performance appraisal systems as contrary to TQM principles. Points made against current systems included that they: encourage competition between individuals, resulting in a divisiveness which fosters "suboptimization of the organization's goals"; decrease objectivity because an employee's performance is often inextricably linked to systems and processes outside his or her control; and, demoralize employees by damaging self-image and self-esteem. Overall, current systems were seen as "hamper[ing] efforts to change." While most interviewees confessed not having any solutions to the negative effects of individual performance evaluations, two organizations had actually rewritten job descriptions to align with organization-wide objectives, as opposed to divisional or departmental

objectives. In addition, three interviewees were participating in an experimental performance appraisal system, called PACER SHARE, which aims to research the viability of a performance appraisal system without individual performance evaluations.

Performance evaluation also led to questions concerning promotions and career development based on TQM principles. In some organizations, the number of job classifications had decreased. This change provides increased human resource flexibility by increasing the number of skills required for promotion or pay increases. Further discussion of alternative performance appraisal, recognition and award systems is contained in Section V.

e. Resistance to Change

Resistance to change was the obstacle to TQM implementation most frequently cited, by nine of the ten top executives. Examples of this resistance included: "people think TQM is a program, not a philosophy;" people have "too much to do" because they see quality as an addition, and not part of, their jobs; and senior and middle management "have the most vested in the old system." For example, one interviewee commented learning that in his engineering oriented organization, the engineers' preference for articulated, well-planned "final answers clashed with the continuous improvement orientation of TQM." The most common methods recommended by interviewees to overcome resistance to change were persistence, leadership, education and training. According to one interviewee, "since TQM is people-dependent" leaders must spend time on: 1) reducing fear, 2) communication, and 3) empowerment in order to affect change. These areas are discussed in more detail below.

1) Reducing Fear

Fear demonstrated by the workforce was seen as based in the historical tradition of senior leadership to "crack the whip" to achieve success. Methods recommended to dissolve fear included: effective communication, sharing power and information, and prompt decisions on process action team recommendations. Most importantly, interviewees reported learning "the hard way" that actions truly speak louder than words. In fact, one interviewee professed a talent for leadership based on fear. During his TQM implementation, this interviewee could not keep himself from screaming, "Just do it!" when faced with urgent requirements. He learned that his innate ability "to blow off steam" clashed with the more active listening role and patiently persistent behavior as a foundation for transforming the workforce. Another interviewee accepted a recommendation from a process action team to alter the existing structure of the organization with the goal of improving customer service. While this top executive personally believed that changing structure was not the only or best answer, he quickly took action to accept the recommendation, thereby supporting the new change process and easing fear of change.

Several interviewees also expressed past frustrations at some supervisors and middle managers who tried to block initial TQM efforts on the front-line due to their own fear and lack of understanding. These interviewees noted that the same strategies of top management commitment, education and training, and better communication are necessary for reducing fear and resistance in middle management. At one organization, however, the top executive could not persuade one particular middle

manager to embrace TQM as a way of business. In this case, specific criteria based on organization-wide objectives were established to be the basis for the manager's performance evaluation; the result was declining performance evaluations as well as uncooperation and stagnation within his department. During the interview, the top executive felt that if the middle manager could not change soon, he would be replaced.

For several interviewees, another way to confront fear of change was a "significant, emotional event"; in several cases, job security in the shrinking federal sector provided a successful focus to achieve easier acceptance of TQM for organizational survival. In one example, the top executive promised no one would work themselves out of a job; as long as the organization continuously improved and operated competitively, excess personnel would be kept on to participate in continuous improvement tasks. However, in yet a different organization, fear of organizational survival grew uncontrolled because top management failed to communicate its future intent to the workforce; results included a workforce intensely agonizing over job security and not primarily focused on quality.

2) Communication

All interviewees advocated improving communications as part of their TQM implementation. Strategy formulation, and vision and values statements were manifestations of top management's early commitment to TQM and provided a "critical, unifying dimension" for communication. Other interviewees recommended "open-door policies." One interviewee described formation of a communication process action team requested by his employees. Consisting of the commanding officer, executive officer and other senior leaders, this team's purpose was to improve all methods of

communication to the workforce. Overall, less emphasis was placed on traditional, formal methods of communication such as Captain's Call; instead, communication mechanisms such as management by wandering around, group or peer-to-peer awards, and various types of luncheons, newsletters and other written media were reported. Innovative ideas in recognition and communication in support of TQM are discussed in Section V.

3) Empowerment

"Unleashing the workforce" was of prime concern to the interviewees, who believed that building team spirit, "coaching as opposed to cracking the whip," and higher levels of employee involvement were keys to empowerment. Responses ranged from "building team spirit to strengthen camaraderie," to competition for quality awards as a way to strengthen both self-assessment and team spirit. While varying in name, number and structure, work groups such as executive steering committees, quality management boards and process action teams were viewed by all interviewees as allowing employees fuller participation in organizational processes and goals. Autonomous or self-managing work teams were discussed as experiments at three of the participating organizations as efforts at empowering the workforce, and are more fully described in Section V.

f. Relentless Pursuit of the Quality Transformation

Five of the ten interviewees identified persistence in pursuit of their quality transformation as mandatory for long term success. Besides "relentless," other adjectives to describe management efforts included "ruthless," "exhaustive," and "never-ending." Sharing experiences was promoted by top management at several organizations in order to "sustain momentum" and enrich their organizations. This

opportunity was afforded to several interviewees through their active participation in local area improvement councils. Interaction with customers and vendors was also seen as "broadening quality perspective and achievement." For example, several interviewees used customer liaison roles and customer education as methods to achieve customer satisfaction; these topics are discussed later in this chapter.

In another vein, reaching "critical mass" was brought up by two interviewees; they learned that achieving this level of commitment took a lot longer than they thought. They commented that even though pockets of model TQM units existed within their organizations, "true acceptance by the critical mass" was much more difficult to achieve. Although critical mass is a dynamic and somewhat elusive quality, all except one interviewee felt confident of having achieved or knowing when he would achieve this level of support.

2. Question 2: Organizational Structure

- "Has your organization changed at all structurally as a result of your TQM implementation?"

Nine of ten interviewees answered affirmatively in response to this question. Descriptions of actual changes fall into three categories: 1) flattened structure, 2) shifts from functional to product orientation, and 3) self-managed work teams.

a. *Flattened Structure*

Six of ten interviewees reported flattening of existing organizational structure during or before TQM implementation. Two organizations reduced the number of supervisors by 27% and 40% during organizational streamlining. Another organization experienced a flattening from six to three management layers across its entire

organization. Yet another organization reorganized from 12 to seven departments and from four to three directorates, while keeping excess personnel onboard for process improvement tasks.

b. Functional to Product Orientation

Four of ten interviewees, a majority from engineering-based organizations, described a complete reorganization of work based on "mini-factories." All three organizations have participated in a move away from functional work arrangements toward product teams. Traditional functional structures are characterized by hierarchy, routine tasks and a relatively stable environment, while product or project orientations tend to be more flexible and decentralized; for example, at one organization, "level of control for product line structure belongs to the product line manager."

c. Self-Managed Work Teams

Three of ten interviewees described an alternative work structure currently under experimentation and use--self-managed work teams. At one organization, self-managed teams develop their own work schedules and manage resources including annual leave. At another, self-managed work teams were viewed as another move toward empowerment, as opposed to more traditional methods to move decision-making down the hierarchy. Self-managed work teams are further discussed in Section V.

3. Question 3: Strategic Planning and Implementation

- "Does your organization have a strategic plan/strategic quality plan?"

Only two interviewees started TQM implementation with quality fully integrated with the organization's strategic plan. Eight interviewees noted starting TQM implementation with separate documents on strategy and quality. One organization described the importance of an integrated,

living strategic document. Currently under development, this document will contain organizational vision and plans for finance, capital assets, marketing, customer service, among other areas, for the next one to five years. Other organizations also stressed the importance of spending adequate amounts of time and focus on the strategic planning process. For example, one organization conducted numerous planning sessions of full and half-days over a three month period to develop its strategic plan. Another key point for successful implementation was described as including the right people in the whole strategic management process; for example, one organization invited its labor unions to join its strategic management board as of August 1, 1991.

4. Question 4: Customer Satisfaction

- "How does your organization identify, measure and track customer satisfaction?"

Interviewees offered various internally and externally oriented practices which are elaborated below. Externally oriented practices include: 1) customer evaluation cards distributed with products, 2) customer surveys, 3) customer liaison roles, 4) customer education, and 5) official deficiency reports; internally oriented practices include: 6) employee attitude surveys and 7) listening as an information-gathering tool.

a. *Customer Evaluation Card*

For those organizations with a physical output, one method of eliciting customer feedback is a self-addressed, stamped customer evaluation card packaged with each product, which gives the name and telephone number of the technician who repaired or produced it. A similar practice uses stickers attached to all outgoing products with a phone number to call if the customer experiences a problem. On a larger

scale, one organization sends a personal letter from its commanding officer with each aircraft it fixes, also with a name and telephone number for questions or problems that the customer experiences. At another, jet delivery is accompanied by a personal phone call from the commanding officer to the squadron commanding officer as a warranty to fix any problems "on the spot."

b. Customer Surveys

Four organizations used surveys as an additional method of eliciting customer satisfaction. These surveys ranged from periodic to annual, and from an all inclusive customer list numbering 800 to a random sample of the same number. Surveys were viewed as a viable method to gather a broad base of customer feedback while also providing a baseline for continuous improvement. A caution about surveys was suggested by one interviewee who felt that surveys failed to gather the kind of honest, detailed response which he felt was more easily achieved using the methods listed below.

c. Customer Liaison

Four organizations utilized a liaison role to interact with customers. Two organizations have liaison programs that either physically bring their production and planning personnel to operating squadrons in order to determine customer desires, or actually establish an on-site representative at the customer's location. This liaison role brought up an interesting dilemma in satisfying numerous customers with often conflicting requirements. A common example mentioned by the interviewees was the situation where the end-user of the product or service does not control the financial resources to pay for the product or service. No

interviewee had an easy solution to this problem, except to "get close to all the customers" and facilitate the customers getting close among themselves.

Face to face communication was advocated by nine of ten interviewees as a method to get closer to the customer. Such communication manifested itself in a variety of forms. The interviewees prescribed lots of "face time with customers," "customer meetings and working groups," "person to person interviews," and "customer involvement during program reviews."

d. Customer Education

Two interviewees specifically felt a responsibility to educate their customers as part of their TQM implementation. One organization developed a customer education team which travels to the customer. Another organization conducts its customer visits on its own site so that its customers can become educated about its capabilities and processes. This sharing of information is aimed at improving customer relationships and sharing information, with customer satisfaction as its goal.

e. Official Deficiency Reports

Six of ten interviewees relied on formal deficiency reports submitted by the customer as another method to measure customer satisfaction. One interviewee recommended a single point of contact for handling this type of report. Other interviewees commented on the customer's willingness to accept mediocre results due to the time and effort required to process a complaint. However negative in content, this type of feedback was viewed as invaluable in looking for trends in output. Interviewees also agreed that this passive method of eliciting customer satisfaction should be supplemented by other, more active methods.

f. Employee Attitude Surveys

Six of ten organizations used formal surveys to elicit internal customer satisfaction. Four of these six organizations concentrated on QWL issues, while the remaining two organizations also used employee attitude surveys to gather information for improving recognition systems, communications and use of personal computers. Only two of the six organizations actually referred to "assessing climate" or using attitudinal surveys as a "corporate barometer" for quality practices.

g. Listening

Two of ten interviewees advised better levels of communication and listening to identify internal customer satisfaction. While subjective in nature, several interviewees relied on management by wandering around in order to gain verbal feedback from employees as evidence of changed behavior.

5. Question 5: Quality Assessment

- How does your organization identify, measure, and track results of quality efforts?

This question was perhaps the most difficult for the interviewees to answer. The interviewees' responses fell into two categories--one group using a hierarchy of indicators, the other group gathering information "by the seat of the pants." One interviewee called for a change in the current criteria used by DoD in external evaluations of organizational performance. This desire can be explained by the common complaint of interviewees of the conflict between external indicators, often not quality-oriented, and internal indicators focused on customer satisfaction. Several organizations used the Malcolm Baldridge National

Quality Award criteria as a basis for self-assessment of organization-wide quality management, but not specifically as a tool for developing a hierarchy of indicators.

a. Hierarchy of Indicators

The interviewees did agree on customer focus as a basis for quality indicators. One interviewee described looking at private sector industry indicators to form his organization's own indicators. Another interviewee, from an organization with a physical output, recommended using constraint indicators such as work in progress and throughput as discussed in The Haystack Syndrome by Eli Goldratt and Jeff Cox (1986). From a logistics organization, one interviewee recommended a quality indicator based on training and use of team-building concepts in day-to-day work.

Several organizations use a hierarchy of indicators to assess overall quality performance. In particular, one organization uses performance measures such as quality of products and services, customer satisfaction and fleet readiness, employee satisfaction, resource management, financial health and innovation. Still another organization described using existing information resource systems as a source for seven performance indicators based on the work of Scott Sink. These indicators are: effectiveness, efficiency, quality, productivity, quality of work life, profitability, and innovation (Sink, Tuttle & DeVries, 1984). While these seven indicators are not mutually exclusive in quantifying organization performance, one key point is that productivity is not the most important or critical element in determining overall quality.

Sink's third indicator--quality--was viewed as the most difficult subject to measure. Cost of quality or lack of quality is still being developed as a quantifiable indicator of performance; however, so far, the cost of not doing quality work or not providing TQM training has eluded quantification.

b. Seat of the Pants

Other measures of quality which were recommended by the ten interviewees included perceiving a feeling of team commitment with proof in changed behaviors. Employees' candidness during meetings was seen as a prime example. Other subjective methods used were professional knowledge, judgment, and improved performance noted by producing a better product for the same dollars.

B. SURVEY

The purpose of this section is to summarize results from the surveys of the ten organizations' executive steering committees. Table 5 shows the means and standard deviations for the eight critical factors of quality management (Sarah et al., 1989; Sarah, 1991). They provide a profile of the self-ratings of quality management for the DOD organizations participating in the present study. The 8 critical factors were comprised of 66 questions that were rated on a scale of one to five with five being a strong indicator of a given quality feature. Five of the eight critical factors had an average score above the midpoint score of three. The three most highly rated factors were role of the quality department ($\bar{x}=3.99$), role of management leadership and quality policy ($\bar{x}=3.72$), and training ($\bar{x}=3.70$). Three critical factors--supplier quality

Table 5: DOD SELF-RATINGS ON THE EIGHT CRITICAL FACTORS OF QUALITY MANAGEMENT

Critical Factor (adapted from Saraph et al., 1989)	mean (n=102)	std dev
Role of management leadership and quality policy	3.72	.59
Role of the quality department	3.99	.52
Training	3.70	.57
Product/service design	3.32	.57
Supplier quality management	2.50	.66
Process management	2.86	.47
Quality data and reporting	2.91	.70
Employee relations	3.36	.56

management ($\bar{x}=2.50$), process management ($\bar{x}=2.86$), and quality data reporting ($\bar{x}=2.91$)--scored below the midpoint score of three.

These data support the information gathered during the interviews. (See Table 3 for the component items for the eight critical factors surveyed.) In light of the interviews and documentation, the ten DOD 'exemplar organizations' have spent most of their time on 'first steps' in the areas of: quality as a part of every employee's job, top management leadership and commitment, and training. The lower self-ratings on factors of supplier quality management, process management, and quality data and reporting, are also supported by data collected from the interviews and documentation. For example, the amount of quality education provided to suppliers, technical assistance provided to suppliers, and

involvement of suppliers in the product/service development process were reported to be limited or non-existent. In addition, the degree of automation in the inspection process, clarity of instructions given to employees, and "fool-proof" designs were either being worked on or non-existent. For quality data and reporting, the interviewees had particular difficulty specifying cost of quality data, let alone its availability to employees within their organizations. As a final point, the lowest rated factor of supplier quality management is an area which several organizations had taken active steps to improve, although the majority of participating organizations did not focus on this area or had emphasized internal customers rather than external customers.

V. INNOVATIVE PRACTICES

As noted earlier, the data collection associated with this research design included interviews, a survey questionnaire and other supporting documentation. From these sources, specific innovations emerged that have implications for future practice, such as "best practices" or unique approaches that might be useful to other organizations implementing TQM. Specific practices are identified by organization, with points of contact noted in Appendix C. Issues in this chapter are separated into five sections: 1) strategic planning and implementation, 2) self-managing work teams, 3) training, recognition and reward systems, 4) performance appraisal systems, and 5) communication.

A. STRATEGIC PLANNING AND IMPLEMENTATION

1. Process

The Naval Ships Systems Engineering Station (NAVSSES) in Philadelphia, Pennsylvania provided an easy to understand framework for their strategic planning and implementation process. This particular organization uses a top-down, participative approach, with a large group consisting of approximately 70 management personnel, in order to arrive at a consensus. The framework relies on Shewhart's Plan-Do-Check-Act cycle, espoused by W.E. Deming among others (Deming, 1986), and is shown in Figure 1. During the "plan" phase, an organizational systems analysis is completed, strategic objectives (long term) and tactical objectives (short term) are determined, and the implementation is planned. The "do" phase involves actual implementation, while the "check" phase relies on performance measurement. Then, during the "act" phase, an implementation

review is conducted and the entire process is evaluated for improvement, thus informing revised planning and a continuation of the cycle. This illustrates how the strategic quality plan can be developed in a flexible and incremental manner in order to succeed with implementation in a complex decision-making environment.

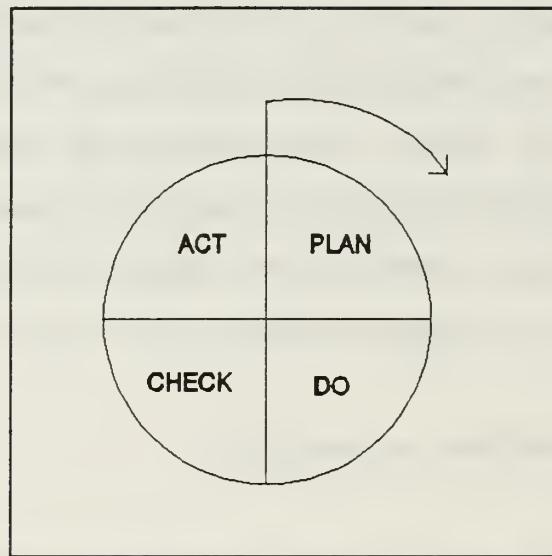


Figure 1: Shewhart Cycle

2. Bill of Rights

Three organizations promote a "quality bill of rights" as a foundation for the paradigm shift to quality (QIP 3, 5, 6; 1991). For example, the Sacramento Air Logistics Center (SM-ALC) uses this document to build a foundation of trust to encourage actions that contribute to safety, quality and productivity. These rights include: the right to challenge business as usual; the right to be heard; the right to expect commitment to quality; the right to place quality before production; and, the right to feel genuine pride in their products and services.

In addition, SM-ALC complements their Quality Bill of Rights with their Supervisor's Code of Professionalism. This code serves as a philosophy of ethics and outlines "the behaviors employees should expect from their supervisors as well as the behaviors supervisors should expect from themselves." The major elements of the Supervisor's Code of Professionalism are: provide leadership, demonstrate followership, communicate understanding, demonstrate integrity, and foster team participation. Taken together, the principles contained in these two documents can create the internal customer focus envisioned by the strategic plan. (QIP 5, 1991)

B. SELF-MANAGING WORK TEAMS

The top executives at the Naval Avionics Center (NAC) in Indianapolis, the 1926th Communications-Computer Systems Group (CCSG) at Warner Robins Air Base in Georgia and the Aviation Supply Office (ASO) in Philadelphia all described implementing self-managing work teams to improve quality, productivity and QWL. Typically, team members have a variety of skills relevant to the group task as well as discretion over task assignments and work schedules. These expanded responsibilities illustrate the high degree of "decision-making autonomy and behavioral control" that can be placed at the workgroup level (Manz and Sims, 1984). The three organizations with self-managing work teams have little evidence of success due to the short life span of these experimental teams. While these teams have not spread to their entire organizations, the interviewees expressed satisfaction with current progress and interest in continuing the experimental teams.

Private sector successes have already been documented in autonomous work groups (Manz and Sims, 1982; Myers, 1985; Poza and Markus, 1980; Trist, Susman and Brown, 1977; Walton, 1977; Wall et al., 1986). Positive results include: a substantial and lasting effect on employees' intrinsic job satisfaction, improved productivity through elimination of supervisory positions and higher levels of employee involvement and participation. A recent survey of Fortune 1000 firms showed 28% of the businesses using self-managed work teams and an additional 23% planning to implement them through 1991 (Cohen and Ledford, 1991).

One implication is that future leaders may become those individuals who actually facilitate self-managing work teams to lead themselves. This change in the role of managers/leaders also entails a new look at desirable leadership behaviors, such as exercising influence through how the manager frames group tasks, structures the group, and helps the group to get started and headed in the appropriate direction (Hackman, 1987, p. 338).

C. QUALITY MEASUREMENTS

1. The Management Healthcheck

At NAC, an internal, self-evaluation tool was developed to assess how organizational principles are being used to create an environment of continuous improvement. At the customer's (manager's) request, the Management Healthcheck Team conducts a review of his/her organization unit. Data is collected from employee interviews, statistical data, customer and supplier surveys, and employee questionnaires. Feedback results provide the manager with information for

identifying personal development needs and development needs of the unit. (QIP 2, 1991)

2. Supplier Quality Management

Informally known as the Blue Ribbon Contractor program, suppliers are measured on the basis of quality, on-time delivery and cost to improve overall quality. At NAC, the program allows contracts to be awarded to other than the lowest bidder, if the contractor demonstrates exemplary performance and if payment of such a premium is determined in the government's best interest. Results include a decrease in late delivery rates of most frequently used blanket purchase agreements (BPA) from 68% to 15%; receipt of defective lots also decreased from 11% to 6% (QIP 2, 1991). The SM-ALC has also formalized the contracting officer's authority to exercise professional judgment in awarding price differentials on contracts from ten to 20% (QIP 5, 1991).

D. TRAINING

1. Exposure

Education and awareness of TQM principles and quality practices were instituted in a variety of forms across the ten participating organizations. Several organizations have developed extensive video libraries. At NAVSSES, the video library contains 76 titles by experts such as Peters, Kanter, Conway and Deming; they are shown in departmental training or at lunchtime in a discussion-oriented session. In addition, the videos are available on loan for home-viewing by any employee (QIP 10, 1991).

At the Naval Supply Center (NSC) in San Diego, California, managers have participated in the "Masters of Excellence" program, which features live presentations from America's top consultants in the quality arena. At SM-ALC, education is also enhanced by satellite transmissions of quality seminars (QIP 5, 1991). Another way to gain exposure to quality practices is rotational assignments. At NAC, managers are temporarily assigned to NAVAIR headquarters for a three to nine month period. This allows the managers to enhance their customer awareness and to learn of quality practices in use at a variety of other successful organizations (QIP 2, 1991). "Lunch and Learn" sessions were a successful way to expose employees to TQM at the Navy's Aviation Supply Office in Philadelphia, Pennsylvania. Completely voluntarily, employees can attend educational sessions conducted by the organization's executive steering committee members, with follow-on discussion of quality topics (QIP 7, 1990).

2. Learning Centers

Several organizations have created learning centers to facilitate TQM education and new skills training. At SM-ALC, the Team Building Center's goal is to promote employees' exercise of "self-direction." The Center's learning sessions focus on "experiential interaction" in the following areas: common ground, committed action, communicating openly, collaboration vice competition, customer focus, and clear goals and roles. Each session introduces 20 member work teams to a systematic approach to seek out, understand and satisfy internal and external customers' needs and expectations. (QIP 5, 1991) Other examples of learning centers are the Computer Information Center at NSC and the Learning Center at ASO. The ASO has doubled training dollars expended

over the last few years on orientation to TQM concepts and SPC targeted at the entire workforce, statistical analysis, and in-house facilitator and instructor training. NSC also expanded into personal computer training in "Statistical Process Control for TQM" and "Easy Flow," a flowcharting software package. (QIP 3, 1991; QIP 7, 1990)

3. Competency Based Certification

Competency based certification, developed by NSC, identifies skills, competencies and tasks of an occupation, and designs a structured training program to ensure that the employee can perform his/her job. Formal classroom training is accompanied by on-the-job certification, and an electronic tracking system of employee certification status. Upon completion of certification, an employee receives a pin and certificate from the commanding officer. (QIP 3, 1991)

At NSC, training is based on the idea that, "the best vehicle to understanding a particular concept is to be required to teach it to someone else." With this in mind, all course materials have been developed in-house for supervisor training, employee training and facilitator training. A comprehensive list of these and other course materials is contained in Appendix D. Sharing this wealth of information is possible, in part, through the Competency Based Certification Library at the Fleet Material Support Ofice (FMSO) in Mechanicsburg, Pennsylvania. FMSO retains copies of TQM instructor guides, student guides, viewgraphs, and other course material from NSC developed courses. In addition, NSC has developed a role for "cadre" instructors who teach NSC courses at the request of other activities. The cadre instructor concept has increased the level of self-development and knowledge of the participants by

enabling them to become masters of certain types of training materials. (QIP 3, 1991)

E. RECOGNITION AND REWARD SYSTEMS

There is no one best set of reward practices because it is impossible to design an effective reward system without knowing the other features of the organization. The ultimate goal is to develop an integrated human resource management strategy that encourages appropriate behaviors and attracts people with the right skills (Lawler, 1987, p. 270). Examples of successful recognition and reward systems for the participating organizations discussed below were a result of dialogue from many levels within each organization, in order to improve existing systems.

1. New Ideas

Several organizations provided innovative examples of recognition and reward systems. In terms of new ideas, NAC's Better Idea Program allows employees to submit job-related improvement ideas they can implement themselves. The Better Idea Program provides an avenue for new ideas which are not covered by the official Beneficial Suggestion program which only rewards ideas that are not related to the employee's normal job (QIP 2, 1991). Similarly, NAVSSES' Bright Idea Program focuses on small improvements or little steps that make up the continuous improvement process (QIP 10, 1991). At SM-ALC, the Good Ideas for the Taking (GIFT) Program also elicits employee suggestions which can only be disapproved at the top management level (QIP 5, 1991).

The 'Order of the Skunk' is another method used at NAC to recognize individual or team ideas relative to research, engineering, quality, manufacturing or production support functions. In addition to admission to the 'Order,' rewards include a reserved parking space, certificate, jacket patch and coffee cup (QIP 2, 1991). The SM-ALC also seeks innovative ideas through its Top Brass In Box program, which allows for improvement suggestions directly to the top executive, and the Director's Hotline, which consists of an answering machine for anonymous suggestions (QIP 5, 1991).

2. Special Acts

At NAVSSES, the Special Act Program covers instances of one time awards for individuals or groups who benefit the entire organization. Rewards include cash or letters of appreciation and are the principle, formal method for recognizing teams. At ASO, the "Unsung Hero" award provides a way to recognize individual or group contributions to getting the job done, for those groups or individuals that do not typically have much organizational visibility (QIP 7, 1990).

3. Peer to Peer Recognition

At ASO, groups or teams can award other groups or teams for excellence in customer and supplier satisfaction. Actual rewards include a plaque, engraved with the team's name, placed in ASO's Hall of Fame along with a presentation in front of the entire workforce (QIP 7, 1990). The ASO also uses its "You Made a Difference" program as a method of peer to peer awards. The recommending employee's work group must agree on the award, which manifests itself as a standing ovation by his/her peers. In addition, a certificate is presented, photographs taken, and a lottery

ticket issued for Recognition Day. At NAVSSES, "Pride in Performance" (PIP) is yet another good example of providing "on the spot" peer recognition for contributions. Any employee may award another with a PIP button, regardless of organizational level or location. Its purpose is to inspire cooperation and teamwork among peers (QIP 10, 1991).

4. Ceremonies

One visible method of awarding employees is ASO's Recognition Day, a biannual celebration of employee contributions. For example, special prizes are awarded to randomly drawn contributors to previous awards such as the "You Made a Difference" program. Rewards include lunch with the commanding officer, acting as the commanding officer for a day, reserved parking, or a pass to the fitness center (QIP 7, 1990). At NAVSSES, public recognition is also of prime concern, as evidenced by monthly Awards Ceremonies hosted by the commanding officer (QIP 10, 1991).

5. Productivity Gain Sharing

Rewards can be based on job position, skill or performance. Typically, government organizations base rewards on a combination of job position, seniority and individual performance. Organizations attempting to reward behaviors congruent with organizational objectives tend to base rewards on either skills or performance (Lorsch, 1987, p.260). A strength of skill-based rewards is that it communicates to the employee an organizational concern for his/her personal development. Two important points concerning performance-based rewards include: individuals are usually more satisfied when they perceive rewards based on their performance; but, as people are aggregated together to measure performance, group performance begins to overshadow the individual

(Lawler, 1981). The discussion of PACER SHARE in the performance appraisal section below will provide more information regarding the use of rewards given on the basis of group performance.

With this background, several participating organizations currently utilize productivity gain sharing (PGS) as an employee involvement program aimed at aligning individual behavior with organizational objectives. At NADEP, Norfolk, NADEP, Cherry Point and SM-ALC, productivity gain sharing provides a means for the government to share with employees savings from improved performance (QIP 4, 1990; QIP 5, 1991; QIP 8, 1987). At NAVSSES, a feasibility study is currently being conducted on introducing PGS as an additional method of employee involvement (QIP 10, 1991).

Productivity gain sharing has a strategic basis because gains are defined in terms of the achievement of one or more strategic goals. Four keys to a successful PGS program include: defining the organization's strategic objectives, devoting sufficient resources to feasibility assessment and plan design, commitment to the concept at all managerial levels, and effective implementation. Studies also indicate that organizations which approach gain sharing strategically and incorporate it as a management philosophy are more likely to succeed.

F. PERFORMANCE APPRAISAL SYSTEMS

1. Alignment

Many interviewees agreed to the inadequacies of current performance appraisal systems; several had created useful tools to improve such evaluation. At NAVSSES, management encourages supervisors to include continuous improvement in performance plans. In addition,

continuous improvement is a factor in all selections for supervisory and management positions filled under the Merit Staffing program (QIP 10). At ASO, managers use a common work plan and objectives based on the five goals of its strategic plan. Then, the commanding officer rates unit performance on the work plan in terms of the impact on the organization's overall performance and achievement. Using these two steps, ASO is able to rate its managers (GS/GM only) as a team (QIP 7, 1990). Similarly, NAC's Performance Management Recognition System for managers ties performance evaluation to customer satisfaction and NAC's internally developed leadership principles (QIP 2, 1991).

2. PACER SHARE

Three of the participating organizations are involved in a revolutionary performance appraisal experiment. A five year demonstration project by OMB, PACER SHARE gives waiver authority over civil service personnel regulations in order to increase productivity. So far, SM-ALC has saved over \$3.4 million with a total productivity gain share of \$1361 for each of 1311 participating employees. This example at SM-ALC included early and total involvement of labor unions and also originated the idea of team-building training, now an integral part of the organization's training strategy.

The PACER SHARE program recognizes deficiencies with current appraisal systems and incorporates specific interventions to enhance productivity, increase flexibility, improve quality and timeliness of work, and enrich quality of work life. There are five specified interventions to achieve these goals: job series consolidation, pay banding, revised supervisory grading criteria, revised hiring and

retention criteria, and productivity gain sharing. At SM-ALC, the experimental division has no individual performance appraisals, job series have been consolidated from 66 to six process descriptions, and employees have greater latitude to design jobs and reorganize functions. Formally initiated in 1988, current success in this program is paving the way for considering wider application in the federal sector. (QIP 5, 1991)

G. COMMUNICATION

1. Written Media

Many of the organizations participating in this study used a variety of written media to improve communications throughout their organizations. For example, NAC employs "Ask the Skipper" cards to elicit questions and comments from employees; answers by top management are printed in the command's newspaper (QIP 2, 1991). At ASO, "CO-grams" or one page letters from the commanding officer are used to communicate quality issues (QIP 7, 1990). Norfolk Naval Shipyard has a quality corner in its base paper, while NAVSSES' paper has run a series of articles on quality (QIP 9, 1988). The NAVSSES actually uses its newspaper to report results of using TQM on specific technical processes, as well as feature articles on process action teams (QIP 10, 1991).

2. Electronic Mail

Electronic mail is quickly becoming an innovative source of communications ideas. At ASO, executive steering committee minutes are sent electronically to all supervisors, on a weekly basis. On a larger scale, SM-ALC's 15,000 employees have access to their Distribution Cable

Network, which allows for "newsbreaks" on monitors located throughout the organization (QIP 5, 1991).

3. Meetings

The ASO uses biannual "All Hands" meetings to communicate top management expectations and information to the workforce. Additionally, ASO has eliminated Friday meetings from its managers' schedules, in order to encourage the practice of managing by walking around (QIP 7, 1990). At SM-ALC, another unique meeting idea is for front line employees to meet with trainees during team building sessions, in order to provide first hand description of success stories (QIP 5, 1991).

4. Behavioral Feedback

The ASO used an outside contractor to facilitate an increased rate of behavioral change within its organization. The "Behavioral Feedback System" involved supervisors and managers in a critique of their own behavior, in the spirit of aligning their actions with continuous improvement and empowerment ideals. Subordinates were interviewed about specific supervisor or managerial behavior. Facilitators provided feedback to these supervisors and managers and helped them develop a plan to change their behavior (QIP 7, 1990). According to the top executive, this intervention was the most successful in quickly changing individual behavior, but was also quite expensive; similar in-house practices are under development.

5. Mentoring

Only one organization explicitly described improving employee career development through improved communication. The ASO's strategic plan for 1989 delineated its fifth strategy as "Moving Organization and

Human Resources into the Future" with a supporting objective to establish and implement a formal career counseling and mentoring program. This program provides a source of one-on-one guidance and advice from senior people (mentors) to mid-level employees. Mentors coach employees about how to become qualified and competitive for promotion (QIP 7, 1990).

VI. SUMMARY AND GENERAL CONCLUSIONS

A. SUMMARY

Briefly, this study provides both quantitative and qualitative analyses of TQM implementation in DoD. The research relied on personal interviews of top executives of exemplar organizations in order to elicit lessons learned. In addition, a validated survey instrument was used to measure perceptions of organization-wide quality management by each organization's executive steering committee. Research results included specific identification of lessons learned and innovative practices which may be useful to other organizations implementing TQM.

B. GENERAL CONCLUSIONS

Earlier sections of this report have detailed lessons learned, innovative practices, and provided a general quantitative assessment of quality management. Here, we will offer some more general conclusions which emerged from this study.

1. Comparing Lessons Learned with DoD's TQM Guidelines

The lessons learned by top executives during TQM implementation seem fully compatible with DoD's recommended principles and practices. To review, these lessons learned fell into six categories: 1) top management commitment, 2) a structured approach, 3) training and education, 4) performance evaluation, 5) resistance to change, and 6) relentless pursuit of the quality transformation. These lessons learned appear to cover all of the TQM principles covered in the DoD document, Total Quality Management. That document includes the following as TQM

principles: continuous process improvement, process knowledge, user focus, commitment, top-down implementation, constancy of purpose, total involvement, teamwork, and investment in people (Total, undated).

The lessons learned also seem to touch upon all of the TQM practices cited in the document mentioned above. The TQM practices are based on implementing the guiding principles, demonstrating and reinforcing behavior through systematic and continuous application, and these practices becoming customary and routine. They include: planning and goal-setting, promoting improvement, process improvement, signals, communication, skill-building, resource optimization, and contractor improvement (Total, undated).

While the lessons learned touch upon all of the TQM practices advocated by DoD, it was clear that some had received more emphasis than others. Overall, these exemplar organizations, which are still at relatively early stages of TQM implementation, seemed to give highest priority to the gaining of top management commitment and to the training or educating of employees in TQM. These emphasis areas are not surprising since reaching a "critical mass" of support is essential to sustain the momentum required by a shift to a quality focus. Moreover, the level of excellence or maturity of implementation seemed to vary across these exemplar organizations. Those organizations which had more thoroughly approached all the recommended TQM practices seemed more successful at implementing TQM.

2. Current State of Quality Measurement

Another general finding is that the current state of quality measurements within DOD exemplar organizations can be characterized as

less than mature. The majority of participating organizations are still struggling to measure organization-wide quality management. What is missing in current quality measurement systems is a method to capture an overall assessment of an organization's quality management; for example, potential areas which need to be measured include cost of quality, quality of work life and innovation.

The survey instrument adapted from Sarah et al. (1989) may provide these organizations with additional diagnostic information for evaluating quality. The Sarah study identified eight critical factors of organization-wide quality management and provides operational measures that can form a profile of an organization's quality management practices. In addition, a comparison of these eight critical factors and the Malcolm Baldridge National Quality Award criteria showed additional areas for evaluation--customer satisfaction and quality results. While both of these tools can be used for self-assessment, one advantage of the critical factor survey is that it can be used to evaluate the perceptions of a range of organizational members or customers of the organization's quality practices.

3. Need to Integrate TQM with Strategic Planning

A third conclusion concerns implementation planning. Results from the interview show that a large majority of organizations started implementing TQM without integrating their strategic and quality plans. Instead, most organizations retained separate but somewhat overlapping work groups in the areas of strategy and quality. The lesson learned was that the top executive should not separate quality from strategy--they must be integrated. A related observation of the primary researcher was

that the organizations with more mature TQM implementations tended to work more diligently in all areas, including training, leadership, process management, and quality data and reporting. Less mature organizations tended to focus more narrowly on QWL, training and top management commitment and education, as opposed to emphasis on all aspects of their organizations.

4. An Overall Assessment of Promise

While the results may provide suggestions that will enhance TQM capabilities, they also imply that TQM implementation is either never-ending or quite a long term commitment. All of the exemplar DOD organizations which have been practicing TQM for over three years still do not characterize themselves as mature implementors. However, certain evidence is promising for organizations committed to quality. For example, a recent reduction-in-force (RIF) in the Naval Air Systems Command caused some of its business units to lose funding for up to 20% of civilian personnel. Two of the subject organizations, which also participated in this study, were evaluated for cuts in human resources as a result of the RIF. One organization was subject to a cut of approximately 10%, while the other did not lose one employee. The implication is that the most successful organizations--those that focus on quality and customer service--will also be the ones best able to succeed in a turbulent environment with diminishing resources.

APPENDIX A: SURVEY QUESTIONS

	<u>Extent or Degree of Current Practice Is</u>				
	Very Low	Low	Medium	High	Very High
	1	2	3	4	5
Extent to which the top executive assumes responsibility for quality performance					
Visibility of the quality department	1	2	3	4	5
Specific work-skills training (technical and vocational) given to non-supervisory employees throughout the organization	1	2	3	4	5
Thoroughness of new process/ service design reviews before the process/service is implemented/produced	1	2	3	4	5
Extent to which suppliers are selected based on quality rather than price or schedule	1	2	3	4	5
Use of acceptance sampling to accept/reject lots or batches of work	1	2	3	4	5
Availability of cost of quality data in the organization	1	2	3	4	5
Extent to which quality circle or employee involvement type programs are implemented in the organization	1	2	3	4	5

	Extent or Degree of Current Practice Is				
	Very Low	Low	Medium	High	Very High
	1	2	3	4	5
Acceptance of responsibility for quality by major branch/department heads within the organization					
Quality department's access to top management	1	2	3	4	5
Quality-related training given to non-supervisory employees throughout the organization	1	2	3	4	5
Coordination among affected departments in the process/service development process	1	2	3	4	5
Thoroughness of the supplier rating system	1	2	3	4	5
Amount of preventive equipment maintenance	1	2	3	4	5
Availability of quality data (error rates, defect rates, scrap, defects)	1	2	3	4	5
Effectiveness of the quality circle or employee involvement type programs in the organization	1	2	3	4	5
Degree to which top management (commanding officer/executive director/major department heads) is evaluated for quality performance	1	2	3	4	5
Autonomy of the quality department	1	2	3	4	5

	<u>Extent or Degree of Current Practice Is</u>				
	Very Low 1	Low 2	Medium 3	High 4	Very High 5
Quality-related training given to managers and supervisors throughout the organization					
Quality of new processes/services emphasized in relation to cost or schedule objectives	1	2	3	4	5
Reliance on reasonably few dependable suppliers	1	2	3	4	5
Extent to which inspection, review, or checking of work is automated	1	2	3	4	5
Timeliness of the quality data	1	2	3	4	5
Extent to which employees are held responsible for error-free output	1	2	3	4	5
Extent to which top management supports long-term quality improvement process	1	2	3	4	5
Amount of coordination between the quality department and other departments	1	2	3	4	5
Training in the "total quality concept"(i.e. philosophy of organization-wide responsibility for quality) throughout the organization	1	2	3	4	5
Clarity of process/service specifications and procedures	1	2	3	4	5

	<u>Extent or Degree of Current Practice Is</u>				
	Very Low 1	Low 2	Medium 3	High 4	Very High 5
Amount of education of suppliers by the organization					
Amount of incoming inspection, review, or checking	1	2	3	4	5
Extent to which quality data (cost of quality, defects, errors, scrap, etc.) are used as tools to manage quality	1	2	3	4	5
Amount of feedback provided to employees on their quality performance	1	2	3	4	5
Degree of participation by major branch/department heads in the quality improvement process	1	2	3	4	5
Effectiveness of the quality department in improving quality	1	2	3	4	5
Training in the basic statistical techniques (such as histograms and control charts) in the organization as a whole	1	2	3	4	5
Extent to which implementation /producibility is considered in the process/service design process	1	2	3	4	5
Technical assistance provided to suppliers	1	2	3	4	5
Amount of in-process inspection, review, or checking	1	2	3	4	5

Extent or Degree of Current Practice Is

	Very Low 1	Low 2	Medium 3	High 4	Very High 5
Extent to which quality data are available to non-supervisory employees					
Degree of participation in quality decisions by non-supervisory employees	1	2	3	4	5
Extent to which top management has objectives for quality performance	1	2	3	4	5
Training in advanced statistical techniques (such as design of experiments and regression analysis) in the organization as a whole	1	2	3	4	5
Quality emphasis by customer service employees	1	2	3	4	5
Involvement of the supplier in the product development process	1	2	3	4	5
Amount of final inspection, review, or checking	1	2	3	4	5
Extent to which quality data are available to managers and supervisors	1	2	3	4	5
Extent to which quality awareness building among employees is ongoing	1	2	3	4	5
Specificity of quality goals within the organization	1	2	3	4	5

	<u>Extent or Degree of Current Practice Is</u>				
	Very Low 1	Low 2	Medium 3	High 4	Very High 5
Commitment of the top management to employee training					
Extent to which longer term relationships are offered to suppliers	1	2	3	4	5
Stability of production schedule/work distribution	1	2	3	4	5
Extent to which quality data are used to evaluate supervisor and managerial performance	1	2	3	4	5
Extent to which employees are recognized for superior quality performance	1	2	3	4	5
Comprehensiveness of the goal-setting process for quality within the organization	1	2	3	4	5
Availability of resources for employee training in the organization	1	2	3	4	5
Clarity of specifications provided to suppliers	1	2	3	4	5
Degree of automation of the process	1	2	3	4	5
Extent to which quality data, control charts, etc., are displayed at employee's work stations	1	2	3	4	5
Effectiveness of supervisors in solving problems/issues	1	2	3	4	5

Extent or Degree of Current Practice Is

	Very Low 1	Low 2	Medium 3	High 4	Very High 5
Extent to which quality goals and policy are understood within the organization					
Extent to which process design is "fool-proof" and minimizes chances of employee errors	1	2	3	4	5
Importance attached to quality by top management in relation to cost and schedule objectives	1	2	3	4	5
Clarity of work or process instructions given to employees	1	2	3	4	5
Amount of review of quality issues in top management meetings	1	2	3	4	5
Degree to which top management considers quality management as a way to increase revenues/reduce costs	1	2	3	4	5
Degree of comprehensiveness of the quality plan within the organization	1	2	3	4	5

APPENDIX B: STATISTICAL ANALYSIS OF SURVEY RESULTS

The survey used in this study is adapted from an instrument developed and validated by Sarah, Benson and Schroeder (1989). The Sarah et al. citation provides substantial evidence for the validity of the eight critical factors of quality management by evaluating content validity, criterion-related validity and construct validity.

For this research, the survey was modified by dropping 12 questions that were determined to be unreliable in the original study. As stated in the body of this report, additional modifications to wording were made to fit DoD organizations. The modified survey, containing 66 questions, was formally reviewed by two civilian professors of management in order to ensure the language changes would ease comprehension of the survey questions by the targeted audience, without changing the substantive intent of the questions.

The reliability of the survey data collected for this study was evaluated using the internal consistency method. Cronbach's alpha, which is well suited to attitude instruments in which multiple questions are used to address a single dimension (i.e. training, process management), was chosen to assess internal consistency reliability (Jaeger, 1983). The SPSS/PC+ reliability program was used to conduct the analysis (Norusis, 1990). Missing data, which was minimal, was handled by substituting the median score for each survey question, so as not to exclude any survey responses from this study.

Results for the eight critical factors' reliability are detailed in Table 3 (see Section III), which shows that the reliability coefficients or alpha scores ranged from .73 to .91, all of which are considered

adequate for reliability of research instruments. This analysis demonstrates that different questions intended to measure the same critical factor show convergence (Cronbach, 1951; Jaeger, 1983; Yin, 1984). These results further supported reliability evidence presented by the original developers of the instrument.

A correlation matrix for the critical factors of quality management was completed as an additional measure of discriminant validity, and is detailed in the following table. Because the factors all deal with quality management, significant correlations are to be expected. All but four intercorrelations show at least 50% unique variance, thus supporting discriminant validity. The highest intercorrelation was found between leadership and employee relations ($r=.79$). This suggests that these two dimensions have 62% variance in common, and 38% unique variance. While this is not a strong indication of discriminant validity, it was felt to be sufficient for purposes of this study.

**SCALE TO SCALE CORRELATION MATRIX FOR THE CRITICAL FACTORS
OF QUALITY MANAGEMENT**

Critical Factor	Scale #							
	1	2	3	4	5	6	7	8
Role of management leadership and quality policy (scale #1)	1.0	.58	.66	.71	.31	.46	.72	.79
Role of the quality department (scale #2)	1.0	.49	.58	.32	.37	.48	.58	
Training (scale #3)		1.0	.56	.42	.43	.66	.66	
Product/service design (scale #4)			1.0	.40	.58	.71	.69	
Supplier quality management (scale #5)				1.0	.59	.42	.37	
Process management (scale #6)					1.0	.64	.46	
Quality data and reporting (scale #7)						1.0	.74	
Employee relations (scale #8)								1.0

APPENDIX C: RESEARCH PARTICIPANTS

The executive steering group or committee at each of the following organizations participated in the thesis survey. A point of contact (POC) is shown for each organization as well as the name and title for each organization's interviewee.

Sacramento Air Logistics Center
McClellan Air Force Base
Sacramento, California
Major General Michael D. Pavich, USAF
Center Commander
(POC Colonel Folz
916-633-1164
A/V 633-1164)

Navy Aviation Supply Office
(formerly Defense Industrial
Supply Center)
Philadelphia, Pennsylvania
Rear Admiral James E. Eckleberger, USN
Commanding Officer
(POC Mr. Marvin Sandler
215-697-1375
A/V 442-1375)

Naval Avionics Center
Indianapolis, Indiana
Captain Russell J. Henry, USN
Commanding Officer
(POC Mr. Thomas Sibert
317-353-7470
A/V 369-7470)

Naval Aviation Depot
Naval Station Norfolk
Norfolk, Virginia
Captain Thomas W. Hancock, USN
Commanding Officer
(POC Mr. Ross Haines
804-445-1587)

Norfolk Naval Shipyard
Portsmouth, Virginia
Captain James T. Taylor, USN
Commanding Officer
(POC Mr. Duff Porter
804-396-7092)

Naval Ship Systems
Engineering Station
Philadelphia, Pennsylvania
Captain Dennis K. Kruse, USN
Commanding Officer
(POC Mr. James Summers
215-897-7828)

1926th Communications-Computer Group
Warner Robins Air Logistics Center
Warner Robins Air Force Base, Georgia
Mr. Clifford E. Carroll
Executive Director
(POC Ms. Jeanie Spence
912-926-7687
A/V 468-7687)

Naval Supply Center
San Diego, California
Captain Gary D. Lynn, USN
Executive Officer
(POC Ms. Donna Tierney
619-532-1689
A/V 522-1689)

Naval Aviation Depot
Marine Corps Air Station
Cherry Point, North Carolina
Mr. John C. Adams
TQM Coordinator
(POC Mr. John Adams
919-466-7403
A/V 582-7403)

Navy Aviation Supply Office, Code 10
(formerly Naval Publications
and Forms Center)
Philadelphia, Pennsylvania
Lieutenant Commander Kenneth K. Kittredge, USN
Director, Publications and Forms
(POC Mr. Dennis Cronin
215-697-4919
A/V 442-4919)

APPENDIX D: TQM TRAINING COURSES

The following documents are available for purchase through DTIS and NTIS, with corresponding address and phone information listed at the bottom of the page.

TQM PROCESS ACTION TEAM COURSE (AD A225 197)

- Student Manual
- Plan of Instruction
- Case Study Exercise Handout
- Vu-graphs

TQM QUANTITATIVE METHODS WORKSHOP (AD A225 736)

- Student Manual
- Plan of Instruction
- Vu-graphs
- Answer Key for Selected Exercises

TQM AWARENESS SEMINAR (AD A225 212)

- Student Manual

TQM GROUP DYNAMICS WORKSHOP (AD A225 735)

- Student Manual
- Plan of Instruction
- Vu-graphs

TQM IMPLEMENTORS WORKSHOP (AD A225 141)

- Student Manual
- Plan of Instruction
- Vu-graphs

AN EDUCATION AND TRAINING STRATEGY FOR TQM IN THE DOD (AD A211 942)

AN INTRODUCTION TO THE CONTINUOUS IMPROVEMENT PROCESS: PRINCIPLES AND PRACTICES (AD A211 911)

A TQM PROCESS IMPROVEMENT MODEL (AD A202 154)

*MANAGING FOR ORGANIZATIONAL QUALITY-THEORY AND IMPLEMENTATION: AN ANNOTATED BIBLIOGRAPHY (AD A225 040) (*authors' note: an exceptional reading list)

Above Materials Available From:

Defense Technical Information Center
ATTN: DTIC-FDRA
Bldg. 5, Cameron Station
Alexandria, Virginia 22305-6141
(POC Marcie Stone: 703-274-3848)

National Technical Information Center
(NTIS)
5385 Port Royal Road
Springfield, Virginia 22161
(703-487-4650)

TRAINING SCHEDULE (adapted from Naval Supply Center, San Diego (QIP 3, 1991))

Course/Source/Hours	Dept Heads/Deputies	Division Heads	Supervisors	Facilitators	Non-supervisory employees
Instituting Dr. Deming's Methods for Management of Productivity & Quality (George Washington University - 16 hours)	X	X			
Supervisory Competency Based Certification Program (NSC 26/Contracted Training - 120 hours)	X	*	X		
Introduction to TOM for Supervisors (NSC 26/04/Cadre - 32 hours)	X	X	X		
TQM for Non-supervisory Employees (Dept/Division Heads - 24 hours)			X	X	
Basic Facilitator Training (NSC 26/04 - 40 hours)			X		
Advanced Facilitator Training (NSC 26/04 - 40 hours)			*		
Instructor Training (NSC 26 - 24 hours)	X	X	X	*	
Building Winning Teams (NSC 26 - 4 hours)	*	*	*	*	*
Control Chart Training (NSC 04 - 8 hours)	*	X	X	*	
Basic Management Statistics (Satellite Education Network - 40 hours)	*	*	*	X	*
Statistical Process Control (Satellite Education Network - 40 hours)	X	*	*	*	*

note: X = required training; * = optional training

LIST OF REFERENCES

Carlucci, Frank, "Department of Defense Posture Statement on Quality," Secretary of Defense memorandum, dated 30 March 1988.

Cohen, Susan G. and Ledford, Gerald E., Jr., "The Effectiveness of Self-Managing Teams: A Quasi-Experiment," Center for Effective Organizations, School of Business Administration, University of Southern California, Los Angeles, California, March 1991.

Costello, W., "Implementation of Total Quality Management in DOD Acquisition," Undersecretary of Defense memorandum, dated 19 August 1988.

Cronbach, J. L., "Coefficient Alpha and the Internal Structure of Tests," Psychometrika, Vol. 16, No. 3, September 1951, pp. 297-334.

Crosby, P.B., Quality is Free, New American Library, 1979.

Defense (no author cited) "Total Quality Management: the View from the Top," Defense, January-February 1991, pp. 8-17.

Deming, W.E., "Improvement of Quality and Productivity through Action by Management," National Productivity Review, Winter 1981-1982, pp. 12-22.

Deming, W.E., Out of the Crisis, Massachusetts Institute of Technology, Center for Advanced Engineering, 1986.

Eccles, Robert G., "The Performance Measurement Manifesto," Harvard Business Review, January-February 1991, pp. 131-139.

Francis, Philip F., Caro, Paul W., Cherry, Peter, and Pacine, H. Wayne, Final Report- Ad Hoc Subgroup on Total Quality Management, Army Science Board, March 1990.

Garrett, H. Lawrence III, "Total Quality Management (TQM)," Undersecretary of the Navy memorandum, dated 8 November 1988a.

Garrett, H. Lawrence III, "Department of the Navy Total Quality Management (TQM) Implementation Plan," Undersecretary of the Navy memorandum, dated 4 November 1988b.

Garvin, David A., "Quality on the Line," Harvard Business Review, September-October 1983, pp. 64-75.

Goldratt, Eliyahu M. and Cox, Jeff, The Goal: A Process of Ongoing Improvement, revised edition, North Rivers Press, Inc., 1986.

Hackman, J. Richard, "The Design of Work Teams," Handbook of Organizational Behavior, ed. J. W. Lorsch, 1987.

Hauser, John R. and Clausing, Don, "The House of Quality," Harvard Business Review, May-June 1988, pp. 63-73.

Hoffmann, G.C., "Total Quality Management," Assistant Secretary of Defense (Shipbuilding and Logistics) memorandum, dated 20 December 1988.

Ishikawa, Kaoru, What is Total Quality Control? the Japanese Way, Prentice-Hall, Inc., 1985.

Jaeger, Richard M., Statistics: A Spectator Sport, Sage Publications, Inc., 1983, pp. 93-101.

Juran, J.M., "Japanese and Western Quality: A Contrast in Methods and Results," Management Review, Vol. 67, No. 11, November 1978, pp. 26-29.

Juran, J.M., "The Quality Trilogy," Quality Progress, Vol. 9, No. 8, 1986, pp. 19-24.

Juran, J.M., Juran on Leadership for Quality: An Executive Handbook, The Free Press, 1989.

Kanter, Rosabeth Moss, "Championing Change: An Interview with Bell Atlantic's CEO Raymond Smith," Harvard Business Review, January-February 1991, pp. 118-130.

Kelso, ADM Frank B., "Improving with Quality," Surface Warfare, March-April 1991, pp. 30-31.

Lawler, Edward E., III, "The Design of Effective Reward Systems," Handbook of Organizational Behavior, ed. J. W. Lorsch, 1987.

Lawler, Edward E., III, Pay and Organizational Development, Addison-Wesley Publishing Co., Inc., 1981.

Leonard, Frank S., and Sasser, W. Earl, "The Incline of Quality," Harvard Business Review, September-October 1982, pp. 163-171.

Manz, Charles C. and Sims, Henry P., "The Potential for 'Groupthink' in Autonomous Work Groups," Human Relations, Vol. 35, No. 9, 1982, pp. 773-784.

Manz, Charles C. and Sims, Henry P., "Searching for the 'Unleader': Organizational Member Views on Leading Self-Managed Groups," Human Relations, Vol. 37, No. 3, 1984, pp. 409-424.

Myers, John B., "Making Organizations Adaptive to Change: Eliminating Bureaucracy at Shenandoah Life," National Productivity Review, Spring 1985, pp. 131-138.

National Institute of Standards and Technology, Malcolm Baldridge Quality Award Application, Gaithersburg, Maryland, 1991.

Norusis, Marija J., SPSS/PC+ Statistics for the IBM PC/XT/AT and PS/2, SPSS Inc., 1990.

Peters, Tom, Thriving on Chaos: Handbook for a Management Revolution, Knopf, 1988.

Peters, Tom, "Making It Happen," Journal for Quality and Participation, Vol. 12, No. 1, March 1989, pp. 6-11.

Peters, T. and Waterman, R. H., In Search of Excellence, Warner Books, 1985.

Phillips, Lieutenant Mark D., USN, "Getting Aboard TQL," Surface Warfare, March-April 1991, pp. 28-29.

Poza, Ernesto J. and Markus, M. Lynne, "Success Story: The Team Approach to Work Restructuring," Organizational Dynamics, Winter 1980, pp. 3-25.

(QIP 1) Office of Management and Budget, Quality Improvement Prototype: Naval Publications and Forms Center, Naval Supply Systems Command, Department of the Navy, 1989.

(QIP 2) (no author cited) "Naval Avionics Center: 1991 Quality Improvement Prototype Award Nomination," Indianapolis, Indiana, 1991.

(QIP 3) (no author cited) "Quality Improvement Prototype Award Application, 1991," Naval Supply Center, San Diego, California, 1991.

(QIP 4) (no author cited) "Quality Improvement Prototype Award Nomination 1991," Naval Aviation Depot, Norfolk, Virginia, July 16, 1990.

(QIP 5) Federal Quality Institute, Quality Improvement Prototype: Sacramento Air Logistics Center, Air Force Logistics Command, Department of the Air Force, 1991.

(QIP 6) Federal Quality Institute, Quality Improvement Prototype: 1926th Communications-Computer Systems Group, Warner Robbins Air Logistics Center, Air Force Logistics Command, Department of the Air Force, 1991.

(QIP 7) Naval Aviation Supply Office Letter to Commander, Naval Supply Systems Command, Subject: 1991 QUALITY IMPROVEMENT PROTOTYPE AWARD, 16 July 1990.

(QIP 8) Office of Management and Budget, Quality Improvement Prototype: Naval Aviation Depot, Cherry Point, Naval Aviation Systems Command, Department of the Navy, 1987.

(QIP 9) (no author cited) "Norfolk Naval Shipyard: Self-Nomination for 1989 Quality and Productivity Prototype Award," Portsmouth, Virginia, September 8, 1988.

(QIP 10) (no author cited) Naval Ships Systems Engineering Station: Application for 1991 Quality Improvement Prototype Award, Philadelphia, Pennsylvania, 1991.

Saraph, Jayant V., letter to the author, Subject: Survey Results, dated 10 June 1991.

Saraph, Jayant V., Benson, P. George, and Schroeder, Roger G., "An Instrument for Measuring the Critical Factors of Quality Management," Decision Sciences, Vol. 20, 1989, pp. 810-829.

Secretary of the Army message, Subject: Department of the Army Posture on Total Quality Management, 091600Z Nov 88.

Sink, D. S., Tuttle, T. C. and DeVries, S. J., "Productivity Measurement and Evaluation: What is Available?", National Productivity Review, Summer 1984, pp. 265-287.

Stone, Michael P. W., "Army Total Quality Management (TQM) Program," Undersecretary of the Army memorandum, dated 14 September 1988.

Taguchi, Genichi and Clausing, Don, "Robust Quality," Harvard Business Review, January-February 1990, pp. 65-75.

Total Quality Management, Department of Defense, Washington, D. C., (undated).

Trist, E. L., Susman, G. I. and Brown, G. R., "An Experiment in Autonomous Working in an American Underground Coal Mine," Human Relations, Vol. 30, No. 3, 1977, pp. 201-236.

Troxell, Joseph R., "Service Time Quality Standards," Quality Progress, Vol. XIV, No. 9, September 1981, pp. 27-33.

Tuttle, General William G. T., Jr., Commander's Perspective, U.S. Army Material Command, April 1990.

Varian, Tom, Beyond the TQM Mystique: Real World Perspectives on Total Quality Management, American Defense Preparedness Association white paper, Organizational Dynamics, Inc., 1990.

Wagner, General Louis C., Jr., Commander's Perspective, U.S. Army Material Command, January, 1988.

Wall, T. D., Kemp, N. J., Jackson, P. R. and Clegg, C. W., "Outcomes of Autonomous Work Groups: A Long-Term Field Experiment," Academy of Management Journal, Vol. 29, No. 2, 1986, pp. 280-304.

Walton, Richard E., "Work Innovations at Topeka: After Six Years," Journal of Applied Behavioral Science, Vol. 13, 1977, pp. 422-433.

Yin, Robert K., Case Study Research: Design and Methodology, Sage Publications, Inc., 1984.

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